DOCUMENT RESUME

ED 427 011 SP 038 314

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TITLE The Influences of Physical Science Problem-Solving Activities in Teacher Education Programs.
PUB DATE 1997-11-13
NOTE 9p.; Paper presented at the Annual Meeting of the Mid-South Educational Research Association (Memphis, TN, November 12-14, 1997).
PUB TYPE Reports - Research (143) -- Speeches/Meeting Papers (150)
EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS College Students; Elementary Education; Elementary School Teachers; Higher Education; Logical Thinking; *Physical Sciences; Preservice Teacher Education; *Problem Solving; Student Teacher Attitudes; Student Teachers; *Thinking Skills

ABSTRACT

The purpose of this study was to determine the effects of problem-solving activities in physical science classes designed for elementary education majors. A post-test only control group design was used, with 50 students participating during a 5-week treatment period. The experimental group performed problem-solving activities, while the control group did not perform any problem-solving activities. Data collection occurred at the end of the treatment period. Instrumentation consisted of the Test of Integrated Process Skills II and the Problem Solving Inventory. Multiple linear regression analysis indicated that there were significant differences between the experimental group and the control group. The process skill ability mean score was significantly higher for the experimental group than for the control group. There was also a significant relationship between the independent variable of logical reasoning ability and process skill ability. The experimental group had a better perception of their ability to approach their problems and had more confidence in their problem-solving ability, however, the control group had a better perception in the area of personal control. (Contains 10 references.) (SM)

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ED 427 011

THE INFLUENCES OF PHYSICAL SCIENCE PROBLEM-SOLVING ACTIVITIES IN TEACHER EDUCATION PROGRAMS

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Paper presented at the Mid-South Educational Research Association
Memphis, Tennessee
November 13, 1997

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THE INFLUENCES OF PHYSICAL SCIENCE PROBLEM-SOLVING ACTIVITIES IN TEACHER EDUCATION PROGRAMS

Abstract

The purpose of this study was to determine the effects of problem-solving activities in physical science classes designed for elementary education majors. A post-test only control group design was used for the study in which 50 students participated during a five week treatment period.

The experimental group performed problem-solving activities while the control group did not participate in problem-solving activities. Data Collection occurred at the end of the treatment period. Instrumentation consisted of the Test of Integrated Process Skills II and The Problem Solving Inventory.

Multiple linear regression was used in the analysis of the data. Significant differences between the experimental group and the control group were found. The process skill ability mean score was significantly higher for the experimental group. Significance was also found between the independent variable of logical reasoning ability and process skill ability.

Introduction

Desire for satisfying the curiosity of "knowing" is an ageless quest. Dewey, in 1931, wrote that the future of the world's outcome would be influenced by knowledge. He believed that decision-making increased intellectual ability (Main and Rowe, 1993).

Decision-making through the use of science processes has been deemed essential to the teaching of science for centuries. The hands-on science march has continued to influence the conceptual framework of curricular design into the 1990s and has had great impact on the manner in which science is taught (Esler and Esler, 1993). This manner of teaching displays a clear distinction between teaching only concepts as compared to the process approach where students are able to understand the 'why" of science (Funk, Fiel, Okey, Jaus, and Sprague, 1985).

Most listings of process skills (often called problem-solving skills) generally include activities such as observing, communicating, describing, measuring, and formulating hypotheses. Great emphasis on process skill acquisition was popularized by the beliefs of Robert Gagne' and his explanations according to the hierarchical theory of problem-solving (Collette

and Chiapetta, 1989). His approach has been regarded as appropriate for preservice teachers (Gagne', 1967).

Because the purpose of education is to foster the advancement of intellectual capabilities, preservice teachers need experiences that prepare them for understanding process skills if they are to teach in a manner that strengthens problem-solving ability (Radford, DeTure, and Doran, 1992). Real-world applications leading to increased thinking ability are necessary for proper advancement in the world today (Krulik and Rudnick, 1993). Continued success of humankind has been dependent on inquiry investigations conducted by philosophers and scientists.

Purposes of the study

The specific purposes of the study were to address the following concerns: Would student process skill ability be affected by practice in process skill activities? and (2) Would practice in the use of process skills influence student perception of their problem-solving ability?

Discussion

Because this study was designed to investigate process skill ability, activities from Introductory Science Skills (Gabel, 1993) provided the basis for the problem-solving treatment. The Test of Integrated Process Skills II (TIPS II) and the Problem Solving Inventory (PSI) were administered at the completion of the study to compare the experimental and control groups.

Using multiple linear regression for analysis of the data, statistical evidence showed that the experimental group who had participated in the treatment scored significantly higher in process skill ability ($p = .0211$). A significant relationship ($p = .0183$) between process skill ability and logical reasoning ability was also found.

Although not significant, the results of the Problem Solving Inventory showed the experimental group had a lower standard deviation on two (Approach Avoidance - 10.373 compared to 12.376 for the control, and Problem-Solving Confidence - 7.341 compared to 7.851 for the control) of the three areas addressed as well as on the Problem Solving Total (18.867 compared to 20.0414 for the control). This reflects that the

experimental group had a better perception of their ability to approach their problems, and had more confidence in their problem solving ability; however, the control group had a lower standard deviation for personal control (4.232) than did the experimental group (4.850) meaning they had a better perception in that area than did the experimental. When process skill ability was addresses with the following variables, the subsequent findings were: perception of problem-solving ability (p = .5255), grade point average (p = .0569), age (p = .1293), college classification (p = .1306), ACT score (p = .1881), and college status (referring to whether the student was a junior college transfer or not) (p = .0505).

Educational Implications

If preservice teachers are to develop the art of engaging students in process skill acquisition, then they must be given opportunities to develop the skills themselves. Providing situations where this is possible should be included in the preservice curriculum. Additionally, findings produced from this study offer the possibility that formal reasoning ability and process skill proficiency may not be distinguishable.

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